

# **CULTIVATION PRACTICES**

for

## **FRUITS AND PLANTATION CROPS**



UNIVERSITY OF AGRICULTURAL SCIENCES  
STATE DEPARTMENT OF HORTICULTURE AND  
INDIAN INSTITUTE OF HORTICULTURAL RESEARCH  
BANGALORE

# CULTIVATION PRACTICES for FRUITS AND PLANTATION CROPS

*Sangameshwar*  
Instructor in Entomology  
College of Agriculture  
Hebbal, Bangalore-560024.

**Nov. 1979**

University of Agricultural Sciences, State Department  
of Horticulture and Indian Institute of Horticultural  
Research, Bangalore



## INTRODUCTION

Karnataka State is a home for a wide variety of fruit, plantation and spice crops. This state is one of the largest producers of these crops in the country. Mango, citrus, banana, guava and sapota are the important fruit crops. Among plantation crops, coffee, tea, coconut, arecanut and cashew are important. Pepper and cardamom are the main spice crops of the State.

Even though these crops provide considerable income to the farmers, they may have to be grown with caution in narrow limits of soil and climatic condition.

Application of fertilizers and plant protection measures, play a vital role in getting optimum production. Some of the fruit crops like grapes cannot be grown without practicing plant protection measures.

Keeping this in view the first publication on cultivation practices for fruits was issued in 1975. This second edition is the outcome of the joint effort of the officers of the State Department of Horticulture, Scientists of the Indian Institute of Horticultural Research and Scientists of the University of Agricultural Sciences, Bangalore.

*The information provided in this publication is applicable to average situations and need to be adjusted to local conditions, based on adaptive research and demonstrations.*

Comments and suggestions for further improvement are welcome.

**G. S. Randhawa**  
Director  
Indian Institute of  
Horticultural  
Research,  
Bangalore-560006

**B. K. Bhattacharya**  
Director of  
Horticulture  
Bangalore-560004

**K. A. Jaliha**  
Director of  
Extension  
Univ. of Agril.  
Sciences, Hebbal,  
Bangalore-560024

*Edited by :* **A. Seshadri Iyer**  
Information Specialist  
Directorate of Extension  
University of Agricultural Sciences  
Bangalore

*Published by :* **The Director of Extension**  
University of Agricultural Sciences  
Bangalore - 560 024

*Printed by :* **M/s. Brindavan Printers & Publishers (P) Ltd.**  
12/13, Lalbagh Fort Road,  
Bangalore - 560 004

## CONTENTS

1. Mango	..	1
2. Banana	..	4
3. Limes and Lemons	..	8
4. Mandrin and Sweet Oranges	..	11
5. Grape	..	13
6. Guava	..	19
7. Sapota	..	22
8. Papaya	..	24
9. Pomegranate	..	27
10. Pineapple	..	29
11. Coconut	..	32
12. Arecanut	..	36
13. Cashewnut	..	39
14. Cardamom	..	41
15. Black Pepper	..	44
* Compatibility chart of plant protection chemicals	..	47
* Pesticides—their common names & trade names	..	48
* Participants	..	51



## MANGO

Mango is the most important fruit crop of India. Fruits are delicious and rich in vitamin A and C. Apart from fresh consumption, the fruits can also be used in the preparation of processed products. In addition to the local consumption, the fresh fruits and the processed products are also being exported.

### SOILS

It grows well on all types of soils provided they are deep and well drained. Red loamy soils are quite ideal. Alkaline, ill drained and soils with rocky substrata are unsuitable for its successful cultivation.

### SEASON

It is a tropical fruit which thrives well both under humid and dry conditions. It requires good rainfall during its growing season *i.e.*, June–October and rainless dry weather from November onwards. Rain or cloudy weather during flowering favour the incidence of powdery mildew and jassids. June–July are the ideal months for planting.

### VARIETIES

1. **Alfanso (Badami)**: A popular variety with medium sized fruits of excellent quality both for table and canning purposes. It thrives well in coastal areas.

2. **Pairi (Raspuri)**: It is an early variety producing fruits of medium size with fibreless juicy sweet flesh.

3. **Bangalora (Totapurui)**: A regular bearer, producing big fruits which are slightly inferior in taste. It has good keeping quality. It comes up well in dry interior districts.

4. **Mulgoa**: A shy bearer, producing fruits of large size with excellent edible and keeping quality. Being a shy bearer it may not be desirable to plant on a commercial scale.

5. **Neelam**: A late variety and a regular bearer. Fruits are of medium size. Being a late variety the fruits usually get infested by stone weevil.

6. **Mundappa**: A popular variety of S. Kanara district. Fruits are large with small stone and have excellent quality.

7. **Beneshan (Banganpalli)**: It is a popular variety of Hyderabad Karnatak area. Fruits are large with good quality.

8. **Langra:** It is an important variety of North India. It is an early bearer with fruits of excellent quality.

### INPUTS

		<i>Per hectare</i>	<i>Per acre</i>
1. <b>Grafts</b>		68	27
2. <b>Manures:</b>			
Farm Yard manure or compost – be fore planting		10 tons	4 tons
3. <b>Manures and Fertilisers</b>			
		<i>Per</i>	<i>plant</i>
(a) Fertilizers–1 to 3 years	N	375 g.	150 g.
	P <sub>2</sub> O <sub>5</sub>	138 g.	55 g.
	K <sub>2</sub> O	313 g.	125 g.
Farm yard manure or Compost		40 kg.	16 kg.
(b) Fertilizers–4 to 6 years	N	750 g.	300 g.
	P <sub>2</sub> O <sub>5</sub>	275 g.	110 g.
	K <sub>2</sub> O	625 g.	250 g.
Farm yard manure or compost		75 kg.	30 kg.
(c) Fertilizers–7 to 15 years	N	1.5 kg.	600 g.
	P <sub>2</sub> O <sub>5</sub>	550 g.	220 g.
	K <sub>2</sub> O	1.25 kg.	500 g.
Farm yard manure or compost		125 kg.	50 kg.
(d) Fertilizers–Above 15 years	N	2.5 kg.	1 kg.
	P <sub>2</sub> O <sub>5</sub>	1.25 kg.	500 g.
	K <sub>2</sub> O	1.875 kg.	750 g.
Farm yard manure or compost		250 kg.	100 kg.

*Note:* Apply 50% N and the entire P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O to the soil during June–July. Give the remaining 50% N in the form of foliar spray.

### CULTIVATION

**Spacing:** 13 m. × 13 m. (40 ft × 40 ft.)

**Number of pits:** 68 per hectare (27 per acre)

**Pit size:** 90 cm. × 90 cm. × 90 cm. (3 ft × 3 ft. 3 ft.)

### PLANTING

Prepare the land by ploughing, levelling and harrowing. Dig pits according to the specifications noted above. Fill up the pits with equal quantity of topsoil and compost. Plant the grafts in the centre of the pit, keeping the grafted portion well above the ground level. Provide suitable support by staking. Remove the side



shoots from the stock as and when they appear. Provide protective irrigation for two years whenever there is no rainfall.

### **AFTER CARE**

Plough and harrow the land in between the rows during monsoon. Sow other crops like sunhemp, cowpea or horse gram in between rows, during monsoon. This helps in improving the soil fertility and yield of mangoes. Vegetable crops can also be taken as cover crops whenever irrigation facilities are available. Prepare basins around each plant and apply the recommended dose of manures and fertilizers during June-July. Whenever there are no cover crops grown in between the rows, plough the land 2-3 times. This will not only check the growth of weeds, but also helps in conserving soil moisture. Mango is mostly a rainfed crop but providing 1-2 irrigations during flowering and fruit set will give better yields.

### **PLANT PROTECTION**

**Insects:** Mango hopper, Scale insect, Mealy bug, Leaf eating caterpillar, Red ant, Stone weevil, Fruitfly and shoot borer.

**Diseases:** Powdery mildew, Anthracnose, and Mal formation.

**Phanerogamic Parasite:** Loranthus.

### **Schedule**

1. Spray the trees with 60 g. DDT 50% or 60 g. BHC 50% or 40 g. Carbaryl or 20 ml. Malathion or 20 ml. Endosulfan plus 30 g. Wettable Sulphur in 10 litres of water, once before flowering and again soon after fruitset to control powdery mildew and hoppers.
2. Remove and destroy the malformed inflorescence or shoot.
3. Remove the flowering parasite Loranthus with the haustorial suckers. In severe cases prune the affected branches and apply a fungicidal paste.
4. Spray the plants with 1% Bordeaux mixture to control Anthracnose if noticed.
5. Spray the plants with a bait spray of 10 ml. Malathion and 100 g. jaggery or sugar in 10 litres of water when fruits start ripening to control fruit fly damage.



## HARVESTING AND YIELD

Grafts may start flowering from second year onwards, but regular fruiting should be encouraged only after 4 years. Economic yields can however be obtained only after 10 years. The number of fruits harvested varies with the age of the tree.

<i>Age of the tree</i>		<i>Fruits/plant</i>
5 to 10 years	...	50-500
11 to 20 years	...	500-1500
21 years onwards	...	1500 and above

## BANANA

Banana is one of the major fruit crops of the country occupying more than 14 per cent of the area under fruits. It is a good source of minerals and vitamins. It contains more than 20 per cent sugar, which is a rich source of energy.

### SOILS

Banana can be grown in all types of well drained soils ranging from red loam to deep black. Deep, rich and moisture retentive soils containing plenty of organic matter are ideal for its cultivation.

### SEASON

Banana being a tropical crop, grows well in warm humid weather. Heavy rainfall and constant high temperatures are ideal for its cultivation. Planting can be done at any time of the year but June-July is ideal for planting.

### VARIETIES

More than 50 varieties are grown in different parts of the country. Out of which about ten varieties are popular in the State.

1. **Poovan:** This is one of the most extensively grown table variety. The plant is tall and slender. Fruit is small, with yellow thin skin. The bunch contains about 225 fruits. The fruits are sweet with a pleasant sour taste. The pulp contains undeveloped

seeds. This variety is resistant to 'Panama Wilt' and 'Leaf spot' diseases. It is one of the popular varieties in the state.

**2. Dwarf Cavendish:** It is one of the popular varieties in the state. The plant is very dwarf, about 180 cm (6 ft.) in height and adapts itself to dry and windy situations. The fruits are large, curved with soft and sweet flesh. A good bunch contains about 125 fruits. It is resistant to 'Panama Wilt'. It has great export potential.

**3. Rasabale:** This is one of the most delicious table varieties. The plant is tall. Fruits are of medium size with firm pulp. Skin is thin and has shining ivory yellow colour when ripe and delicious in taste. A good bunch will have about 125 fruits. It is grown in limited areas of the State.

**4. Robusta:** It is a semi tall variety belonging to 'Cavendish' group. Yields large bunches with fingers of standard marketable grade. It is resistant to 'Panama Wilt'. The variety has an excellent potential.

**5. Nendran:** This is a dual purpose variety (cooking and table). Fruits are more than 30 cm. (12 inches) long and angular in shape. The pulp is sweet. This variety is commonly used for making chips.

**6. Maduranga:** This is a variety which is extensively used for cooking. Plants are tall. The fruits are long and angular in shape. A good bunch will have about 100 fruits.

Puttabale, Yelakkibale, Chandrabale and Bodabale are the other important varieties commonly grown in the state.

## INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
<b>1. Suckers :</b>		
(a) Dwarf Cavendish	3000	1200
(b) Robusta	2250	900
(c) Other varieties	2225	890
<b>2. Manures :</b>		
Before Planting	40 tons	16 tons
<b>3. Fertilizers :</b>		
	<i>Per plant</i>	
N ...	180 g. or 900 g. Am. Sulphate	
P <sub>2</sub> O <sub>5</sub> ...	108 g. or 675 g. super phosphate	
K <sub>2</sub> O ...	225 g. or 375 g. Muriate of Potash	



		<i>Per hectare</i> (kg.)	<i>Per acre</i> (kg.)
(a) Dwarf Cavendish:			
N	...	540	216
P <sub>2</sub> O <sub>5</sub>	...	325	130
K <sub>2</sub> O	...	675	270
(b) Robusta:			
N	...	405	162
P <sub>2</sub> O <sub>5</sub>	...	245	98
K <sub>2</sub> O	...	507	203
(c) Other varieties:			
N	...	400	160
P <sub>2</sub> O <sub>5</sub>	...	240	96
K <sub>2</sub> O	...	500	200

### CULTIVATION

#### SPACING

		<i>Number of pits</i>	
		<i>Per hectare</i>	<i>Per acre</i>
(a) Dwarf Cavendish	1.8 m. × 1.8 m. (6' × 6')	3,000	1,200
(b) Robusta	2.2 m. × 1.8 m. (8' × 6')	2,250	900
(c) Other varieties	2. m. × 2 m. (7' × 7')	2,225	890

#### PLANTING

Prepare the land by ploughing, harrowing and bring the soil to fine tilth. Dig pits of 0.5 m. cube (1.5 ft.) at the recommended spacing depending on the variety. Fill the pits with equal quantities of top soil and farm yard manure/compost. Plant sword suckers in the centre of the pit.

*Note:* Do not use water suckers for planting. This will not only delay the harvest but also reduce the yields.

Provide irrigation immediately after planting and give subsequent irrigations once in 4-5 days depending upon the soil and weather conditions.

#### AFTER CARE

Do not allow any side suckers to grow till the main plant flowers. At the time of flowering allow only one sucker for getting a ratoon crop. Apply the fertilizers in 3 split doses at 2, 4 and 6 months after planting. Dig the plot 2-3 times to loosen the soil and check the weed growth. Provide supports by propping to prevent lodging of plants due to heavy bearing and strong winds.

Short duration vegetable and leguminous crops can be raised as inter crops during the first 3-4 months.

## PLANT PROTECTION

**Insects:** Banana Rhizome Weevil.

**Diseases:** Bunchy top, Leaf spot, Panama wilt, Pseudostem rot and Mosaic.

### Schedule

1. Select planting material free from Weevil, Panama wilt Bunchy top and Mosaic.
2. Incorporate 10 g. Carbofuran granules or 5 g. Phorate granules per pit to the soil at the time of planting.
3. In the case of Pseudostem rot remove the severely affected sheaths and swab with Bordeaux paste.
4. In case of leaf spot disease spray 35 g. Copper Oxychloride in 10 litres of water.
5. Remove and destroy plants affected by bunchy top and Mosaic immediately after they are noticed to prevent its further spread.

## HARVESTING AND YIELD

The main crop will be ready for harvest in 12-14 months after planting depending upon the variety. The ratoon crop will be ready for harvest in 6-8 months after the harvest of the main crop. The average yield from different varieties is as follows

		<i>Yield/hectare</i>	<i>Yield/acre</i>
(a) Dwarf Cavendish	...	30-40 tons	12-16 tons
(b) Robusta	...	38-45 tons	15-18 tons
(c) Other varieties	...	20-30 tons	8-12 tons

---



## LIMES AND LEMONS

Limes and Lemons are important acid citrus fruits used in seasoning food, in the preparation of refreshing beverages pickles, commercial citric acid and cosmetics. The fruits are rich in vitamin 'C'.

### CLIMATE

Limes and lemons thrive in warm moderately humid climate. They cannot stand low temperature. Areas free from strong winds are ideal. The limes thrive well in the dry northern districts of the State.

### SOILS

Select areas with well drained loamy soils of 2 to 3 metres depth. Avoid water logged and marshy areas.

### SEASON

Plant seedlings or budded plants during the beginning of monsoon. June-July are the ideal months for planting.

### VARIETIES

#### Lime:

1. Kagazi lime
2. Seedless lime (Tahiti lime)

#### Lemon:

1. Italian lemon
2. Lisbon lemon
3. Eureka lemon

Both seedlings and budded plants can be used for planting. The plants budded on Rangapur lime are suited to heavy soils and those budded on Rough lemon are suited to light soils. In case of lime, use seedlings protected against Tristiza virus disease

### INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
1. Seedlings or budded plants	483	193
2. Manures and Fertilizers :		
(a) Before planting	Farm yard manure or compost	15 kg. per pit
(b) After planting:		
- After one year	Farm yard manure or compost	5 kg. per plant
- After 2 years	-do-	10 kg. per plant

- After 3 years	-do-	15 kg./plant
- After 4 years	-do-	20 kg./plant
- After 5 years	-do-	25 kg./plant
- 6 years and above	-do-	30 kg./plant

		<i>Per plant</i>	<i>Per hectare</i>	<i>Per acre</i>
(ii) Fertilizers:				
Nitrogen	..	500 g.	341.5 kg.	96.5 kg.
P <sub>2</sub> O <sub>5</sub>	..	300 g.	144.9 kg.	57.9 kg.
K <sub>2</sub> O	..	500 g.	341.5 kg.	96.5 kg.

### CULTIVATION

Spacing : 5 m. × 5 m. (15 ft. × 15 ft.)  
 No. of pits : 482 per hectare (193 per acre)

### RAISING OF SEEDLINGS

Select large sized thin skinned juicy fruits for extracting seeds. Prepare raised seed beds of 8 m. × 1 m. × 10 cm. (25 ft. × 3 ft. × 4 inches). Apply about 6 baskets of leaf mould or compost. Also spread of 2cm. thick layer of sand on the bed. Sow fresh seeds in 9 cm. rows (3.5 inches) at 3 cm (1.2") apart.

Transplant seedlings in secondary beds in 60 cm. (2 ft.) rows at 22 cm. (9 inches) apart when they have 3-4 leaves and 5-7cm high. Rogue out weak seedlings.

### PLANTING

Prepare the land by ploughing and harrowing. Dig pits of 0.75 m. (2 ft.) cube dug at 5 m. (15 ft.) apart. Fill the pits with top soil and compost. Plant the budded plants in the centre of the pit keeping the bud joint well above the ground level.

### AFTERCARE

Stake plants immediately after planting. Remove sprouts close to the ground and train the plant to a single stem to a height of 0.75 m. (2 ft.). Prune intermingling shoots and dead wood. Scuffle excess soil lightly and mulch. Remove weeds at fortnightly intervals. Irrigate at an interval of 7-10 days depending on the soil and weather conditions.

### MANURING

Apply farm yard manure or cattle manure in February-March or June at 5 kg. per plant from the 2nd year with an increment of 5 kg. for every successive year reaching a maximum of 30 kg. per plant of 6 years age and above.



The quantity of fertilizers also increases with the age of the plant. An adult plant of 6 years and above should get 0.5 kg. N, 0.5 kg.  $P_2O_5$  and 0.5 kg.  $K_2O$  per year.

Apply fertilizers as per schedule in three equal doses coinciding with three flush periods viz., March–April, June–July (Pre-monsoon) and September–October (Post-monsoon).

### PLANT PROTECTION

**Insects :** Stem borer, citrus butterfly, Leaf miner, Psylla, Aphids, Shoot borer, Scales, Mealy bug, Mites and White flies.

**Diseases :** Canker and Dieback.

#### Schedule

1. Prune back dried twigs if any to the healthy region and spray the plants with 32 g. copper oxychloride in 10 litres of water.
2. Spray the new flush with 20 ml Methyl Parathion 50% or 20 ml Oxydemeton methyl 25% or 5 ml Phosphamidon 100% or 18 ml Dimethoate 30% in 10 litres of water. Repeat the same spray after 2 weeks if Leaf miners, Aphids, Shoot borers and Psylla are noticed.
3. Against Scales, Mealy bugs and White flies, spray the plants with 40 g. Carbaryl 50% and 20 ml. Quinolphos 25% or 20 ml. Methyl Parathion 50% in 10 litres of water. Repeat the spray after 10 days.
4. Against mites, Spray the plants with 25 ml. Dicofol in 10 litres of water.
5. Against Butterfly, spray 40 g. Carbaryl 50% or 15 ml. Endosulfan 35 EC in 10 litres of water.
6. Inject a few drops of Carbon Disulphide or Phenyl 50% or Dichorvas or Insert Aluminium phosphide tablet in the bored holes and plug all the holes with wet soil to control the Stem borers.

### HARVESTING AND YIELD

Normally the bearing starts from 3rd year onwards. Limes mature in about 6 months after flowering. There are two main harvests : July to September and March to June.

An eight year old lime plant bears 1000 to 1200 fruits per year. Italian lemon and other lemon varieties may yield 600–800 fruits per plant per year.

## MANDARINS AND SWEET ORANGES

Mandarins (Santra or loose skinned oranges) and sweet oranges (Sathgudi) are most refreshing delicious and wholesome fruits. They are rich in Vitamin C and are fairly good sources of Vitamins A and B.

### SOILS

Mandarins and sweet oranges can be grown successfully in all types of loamy soils which are deep and well drained. Red loamy soils are ideal for its cultivation.

### CLIMATE

Mandarin grows well under warm humid climate. Hence most of the area under mandarins in the state is situated in the districts of Coorg, Hassan and Chickmagalur, where the annual rainfall, ranges from 150-300 cms. June-July are the best months for planting.

**VARIETIES :** Mandarin, Coorg orange, Sweet orange, Sathgudi, Mosambi, Washington Navel and Valencia late.

### INPUTS

1. Planting material	Per hectare	Per acre
Grafts or Nucellar seedlings	270	108

**Note :** Seedlings : One year old nucellar seedlings as distinguished by their moderate vigour and growth only should be selected.

**Budgrafts :** Plants budded on Rangpur lime, Trifoliate orange Kodakithali, Cleopatra mandarin and rough lemon may be used.

2. Organic manure	Per plant		
at the time of planting			50 kg.
— First year			—
— Second year			10 kg.
— Third year			15 kg.
— Fourth year			20 kg.
— Fifth year			30 kg.
— Sixth year and onwards			40 kg.
3. Fertilizers	Per plant	Per hectare	Per acre
	in g.	in kgs.	in kgs.
First year : N	35	8.950	3.780
P <sub>2</sub> O <sub>5</sub>	135	37.45	14.58
K <sub>2</sub> O	13	3.50	1.40



Second year :	N	120	32.40	12.96
	P <sub>2</sub> O <sub>5</sub>	120	2.40	12.96
	K <sub>2</sub> O	78	21.05	8.42
Third year :	N	270	72.90	29.16
	P <sub>2</sub> O <sub>5</sub>	270	72.90	29.16
	K <sub>2</sub> O	180	48.60	19.44
Fourth year :	N	400	108.00	43.20
	P <sub>2</sub> O <sub>5</sub>	250	67.50	27.00
	K <sub>2</sub> O	400	108.00	43.20
Fifth year :	N	550	148.00	59.40
	P <sub>2</sub> O <sub>5</sub>	370	99.90	39.96
	K <sub>2</sub> O	550	148.50	59.40
Sixth year & onwards :	N	550	148.50	59.40
	P <sub>2</sub> O <sub>5</sub>	370	99.90	39.96
	K <sub>2</sub> O	550	148.50	59.40

#### Sixth year and onwards :

- Spray 1.5 kg. Zn. Sulphate, 1 kg. Magnesium Sulphate, 500 g. Magnesium Nitrate and 1.5 kg. lime in 450 litres of water during May & June.
- Spray again with 1.5 kg. Zinc sulphate, 750 g. Magnesium Sulphate, 750 g. Magnesium Nitrate and 500 g. Urea in 450 litres of water.

### CULTIVATION

#### PLANTING

Prepare the land by ploughing, levelling and harrowing. Dig pits of size 1m. (3 ft.) cube dug at 6 m. (20 feet) apart during April-May. Fill the pits with top soil and compost. Plant budgrafts or seedlings in the centre of the pit. Keep the bud joint above the ground level. Stake plants immediately after planting. Remove all water shoots and sprouts both below and above the bud joint. Train seedlings to a single stem upto a length of 150 cm. Provide irrigation whenever necessary. Remove Loranthus and Cuscuta whenever noticed.

#### AFTER CARE

Apply the suggested quantities of fertilizers in three split doses in a year (March, June and September).

Apply the fertilizers by broadcasting in the basins so as to have uniform distribution in the entire portion of the basins leaving 25-30 cm. (10"-12") around the trunk. Provide mulch and keep the land free from weeds.

### PLANT PROTECTION

**Insects :** Stem borer, Citrus butterfly, Aphids, Leaf miners, Scales, Mites, Whitefly & Fruit sucking moth.

**Diseases :** Leaf fall and fruit rot, Powdery mildew, Citrus canker and Scab.

Follow the same Schedule suggested for Limes and Lemons.

### HARVESTING AND YIELD

The plants start bearing from 4th year onwards but substantial yield can be expected only from 7th year onwards. On an average a plant yields about 1,000 to 1,500 fruits.

---

## GRAPE

Grape is one of the most delicious, refreshing and nourishing fruits of the world. Ripe grapes are easily digested. They contain large amounts of sugars and useful minerals.

### SOILS

Grape can be grown on a wide range of soils. Well drained loamy soils are the best. Shallow, medium black, loamy soils containing a small mixture of lime nodules and ranging from 0.5 to 1 m. (1.5 to 3 ft.) in depth and overlying a porous sub-soil of murum are also suitable for its cultivation. Deep sandy or loamy soils are also good for this crop.

### CLIMATE

Grape requires a warm dry summer and a cool winter. It does not thrive well in heavy rainfall tracts and regions of humid summer. November to January is the best time for planting.

### VARIETIES

1. **Bangalore Blue :** The berry is round and the skin is thick tough, and easily slips from the pulp. The taste is sub-acid. The juice is thick purple in colour and is good for bottling. The



bunch is medium sized and compact. It is hardy and tolerant to pest and diseases.

2. **Anab-e-Shahi** : It is a white, oval, thick skinned, sweet grape of excellent eating quality. It is a heavy yielder. The bunch is medium to large and moderately compact,

3. **Thompson Seedless** : It is a white, round, small seedless grape of excellent eating quality. It is a shy bearer. The bunch is small and moderately compact. This variety is best suited for preparation of raisins.

4. **Gulabi** : It is a round purple variety with a thick skin and a sweet soft pulp possessing a rose flavour. The bunches are medium sized, very thinly filled, loose pyramidal and pendulous. It is a fairly good yielder and is an early variety.

5. **Phakdi** : It is an oval whitish green grape with an extremely thin skin and a soft, sweet pulp. Not suitable for long distance transport. The bunch is large, loose, heavily shouldered on the sides and pendulous in the middle. Quality is good. (Not recommended for new planting).

6. **Bhokari** : It is a round, large seeded green grape with a thick skin containing watery sweet sub acid juice. It is vigorous grower and heavy cropper. The bunch is large, compact, cylindrical, tapering and shouldered. Quality is not good.

7. **Cheema Sahebi** : It is a selection from Pandhari Sahebi variety. Vine is vigorous and heavy yielder. Clusters are large and attractive with medium sized berries.

8. **Black Champa** : It is a new promising variety which is vigorous. It is medium to heavy yielder. Berries are medium large to bluish black. It has high TSS of 24-27 per cent and has good keeping and shipping quality.

## INPUTS

<i>Planting distance</i>		<i>Cuttings Per hectare</i>	<i>required Per acre</i>
1. <b>Rooted cuttings:</b>			
(a)	7.5 m. X 3.75 m. (22' X 11')	450	180
(b)	4.5 m. X 3.00 m. (15' X 10')	725	290
(c)	3.6 m. X 3.6 m. (12' X 12')	755	302
(d)	3 m. X 3 m. (10' X 10')	1090	436
(e)	3.5 m. X 1.8 m. (11' X 5½')	1760	704

2. **Organic manure :** 100 kg. per vine at planting and 100 kg per vine every year.

3. **Fertilizers :**

	<i>Per vine</i>	<i>Summer pruning</i>	<i>Winter pruning.</i>
(a) Nitrogen	..	600 g.	400 g.
(b) $P_2O_5$	..	240 g.	240 g.
(c) $K_2O$	..	—	750 g. at pruning and 750 g. after 60 days.

## CULTIVATION

### SPACING

	<i>Distance</i>	<i>No. of pits</i>	
		<i>Per hectare</i>	<i>Per acre</i>
(a) All varieties except Thompson Seedless.	(1) 7.5 m. X 3.75 m. (22 ft. X 11 ft.)	450	180
	(2) 4.5 m. X 3.0 m. (15 ft. X 10 ft.)	725	290
	(3) 3.6 m. X 3.6 m. (12 ft. X 12 ft.)	755	302
(b) Thompson Seedless	(4) 3.0 m. X 3.0 m. (10 ft. X 10 ft.)	1090	436
	(5) 3.5 m. X 1.8 m. (11 ft. X 5½ ft.)	1760	704

*Note :* (1) The spacing commonly given to Bangalore Blue and Anab-e-Shahi on bower system is the one mentioned at (a) (1, 2, & 3) above. The recent trend is to follow closer spacing and plant more number of vines per acre. Closer spacing gives higher yields and more returns in the early years of planting.

(2) Before laying out a vine yard the farmers are advised to consult the Directorate of Extension of the University of Agricultural Sciences, Hebbal, Bangalore or the State Department of Horticulture Lalbagh, Bangalore or the Indian Institute of Horticultural Research Bangalore for selection of site and lay out.

### PROPAGATION

Commercially grape vines are propagated by 4 to 6 budcuttings, taken from fully matured wood of about six months old. Choose



canes with moderately short internodes for taking cuttings from their mature basal portions. Plant them in flat beds with atleast two buds inserted in the soil. For better sprouting in Thompson Seedless soak cuttings for 12 hours in 250 ppm IBA solution.

### **PLANTING**

Dig the pits of 90 cm. cube (3x'3'x3') during November and allow to weather for about 15 days. Fill the pits with alternative layers of green leaf (Pongamia or Glyricidia) and compost or decomposed farm yard manure and finally top soil. Apply 2 kg. bonemeal or 2 kg. superphosphate and 3 kg. neem cake (to keepaway termites) per pit. Give a soaking irrigation to the pits and allow the soil to settle. Plant rooted grape cuttings after one week.

### **TRAINING**

Grape vine gives higher yields on bower system (pergolal pandal) of training than on other systems of training, (Telephone Kniffin, Cordon and Head). Hence bower system is the only training system commercially practiced in the State.

In the bower system, allow one main shoot to grow along the bamboo support up to the height of the bower. Remove all side shoots. Pinch the main shoot about 6" (15 cm) below the bower and allow two side shoots to grow and spread horizontally in opposite directions over the bower. These shoots form the 'arms' (primaries) subsequently. On these arms allow the 'secondaries' at intervals of 45 cm. (18") These in turn give rise to 'tertiaries' on which 'canes' develop and produce the 'shoots' carrying bunches. During the training period tie the growing shoots regularly once a week with thin strip of banana fibre or jute and remove all the tendrils.

### **PRUNING**

Prune one and half to two year old vines with trunks that have attained the size of the wrist for fruting. Pruning is done to secure good crop and to regulate vine growth. In South India, pruning is done twice a year—once in April (summer) and again in October (winter).

#### **Summer Pruning**

In the month of April remove all the leaves. Cut back the new shoots or current season shoots leaving only one to two buds. This is called back pruning or foundation pruning. Do not cut the growth which is older than a year.

### Winter Pruning

This pruning is usually done in the month of October. Before this pruning, give the vines rest by withholding the irrigation for about 3 weeks and dig the basins of grape vines to a depth of 10-15 cm. (6") . Prune the matured brown coloured canes of pencil thickness back to 5 to 7 buds in Anab-e-Shahi and Bhokri ; 8-10 buds in Thompson Seedless, and 6 buds in Cheema sahebi. Prune weak canes to one or two buds.

### Pruning for two crops

In case of Bangalore Blue and Gulabi varieties two crops are taken in a year. In these cases no back pruning is done in summer. Instead, prune the canes both in summer and winter leaving 4 to 6 buds.

### Staggering of pruning

In order to supply fresh grapes to market for a longer period, the pruning of Bangalore Blue can be staggered throughout the year. Thus, in the same vine yard it would be possible to see some plots being pruned, some bearing crops and some being harvested.

### MANURING

Nitrogen and phosphorus are required for good vegetative growth and fruiting. Potassium is required during the cropping season for improving the colour and quality of berries. Follow the method suggested below for all grape varieties in general and Anab-e-Shahi variety in particular.

**First Year :** In addition to the manures applied while filling the pits, each vine should receive monthly application of 100 g. urea and 200 g. Superphosphate. Apply these fertilizers at a distance of 30 cm. (12 inches) from the vine. Monthly top dressing will make the vine grow fast and cover the bower quickly.

**Second year :** The vine should get 0.5 kg. Nitrogen 0.25 kg. Phosphorus and 0.75 kg. Potash per year.

**Third year onwards :** From third year onwards an Anab-e-Shahi vine should get 1 kg. N, 0.5 kg  $P_2O_5$  and 1.5 kg.  $K_2O$  per year. In April or Summer pruning apply 60 per cent of nitrogen to the vine and the balance 40 % per cent in winter or during cropping season. Apply equal amount of phosphorus at both the pruning. Apply Potash only during cropping season as it is required for formation of sugars in the berries. Apply half of Potash in



### Winter Pruning

This pruning is usually done in the month of October. Before this pruning, give the vines rest by withholding the irrigation for about 3 weeks and dig the basins of grape vines to a depth of 10–15 cm. (6") . Prune the matured brown coloured canes of pencil thickness back to 5 to 7 buds in Anab-e-Shahi and Bhokri ; 8–10 buds in Thompson Seedless, and 6 buds in Cheema sahebi. Prune weak canes to one or two buds.

### Pruning for two crops

In case of Bangalore Blue and Gulabi varieties two crops are taken in a year. In these cases no back pruning is done in summer. Instead, prune the canes both in summer and winter leaving 4 to 6 buds.

### Staggering of pruning

In order to supply fresh grapes to market for a longer period, the pruning of Bangalore Blue can be staggered throughout the year. Thus, in the same vine yard it would be possible to see some plots being pruned, some bearing crops and some being harvested.

### MANURING

Nitrogen and phosphorus are required for good vegetative growth and fruiting. Potassium is required during the cropping season for improving the colour and quality of berries. Follow the method suggested below for all grape varieties in general and Anab-e-Shahi variety in particular.

**First Year :** In addition to the manures applied while filling the pits, each vine should receive monthly application of 100 g. urea and 200 g. Superphosphate. Apply these fertilizers at a distance of 30 cm. (12 inches) from the vine. Monthly top dressing will make the vine grow fast and cover the bower quickly.

**Second year :** The vine should get 0.5 kg. Nitrogen 0.25 kg. Phosphorus and 0.75 kg. Potash per year.

**Third year onwards :** From third year onwards an Anab-e-Shahi vine should get 1 kg. N, 0.5 kg  $P_2O_5$  and 1.5 kg.  $K_2O$  per year. In April or Summer pruning apply 60 per cent of nitrogen to the vine and the balance 40% per cent in winter or during cropping season. Apply equal amount of phosphorus at both the prunings. Apply Potash only during cropping season as it is required for formation of sugars in the berries. Apply half of Potash immedi.

ately after pruning and the other half, 60 days later. The split application of potash is more beneficial than single application at pruning.

### **IRRIGATION**

Irrigate the vines immediately after pruning and fertilizer application. Until the berries attain pea size provide water at intervals of 5 to 7 days and thereafter at 10 days. Stop irrigation completely a week before harvest in order to increase sweetness.

### **IMPROVING GRAPE BERRY AND BUNCH SIZE**

In Thompson seedless variety dipping of bunches at full bloom with 20 parts per million solution of gibberellic acid and 50 ppm at fruitset stages respectively reduces the compactness of the cluster, and increase the size of bunches and berries to almost twice their normal size. In Anab-e-Shahi, gibberellic acid improves berry size and reduces seed content besides improving quality.

### **PLANT PROTECTION**

**Insects :** Cock chaffer beetle, Flea beetle, Thrips, Red Spider mites and powder puff beetle.

**Diseases :** Downy mildew, Anthracnose, Powdery mildew and Rust.

### **Schedule**

#### **April Pruning :**

1. Spray the vines after pruning with 17 ml. Dimethoate or 5 ml. Phosphamidon or 10 ml. Monocrotophos or 20 ml. quinalphos or 10 ml Oxy demeton Methyl or 60 g. BHC 50% or 60 g. DDT 50% with 35 g. Copper Oxychloride or 20 g. Disulfoton in 10 litres of water. Use 375 to 450 litres of spray solution per hectare (150-160 litres per acre).
2. Repeat the same spray mentioned in item (1) above at 12-15 days intervals depending upon weather conditions as well as the incidence of insects and diseases. Use 500-625 litres of spray mixture per hectare for these sprays (200-250 litres of spray mixture per acre).

#### **October Pruning:**

1. Follow the same spray schedule suggested under summer
2. pruning under items (1) & (2) above.

In vine yards affected by powder puff beetle, do not plant castor near the vine yard. Swab the stems of grape with 50% BHC slurry twice a year once during May-June and

again in September-October or cover the main stem with polythene sheets.

*Note :*

- If any of the sprays are followed by rain, repeat the spray immediately.
- Birds will cause ample damage when the berries start softening and start becoming sweet. Keep a regular watch to scare away the birds.

## HARVESTING

Grape bunches do not ripen after harvest. Hence do not harvest immature bunches. Most of the white varieties develop a golden colour when fully ripe, while black grapes usually get dark and uniformly coloured. For the control of post harvest berry drop in Anab-e- Shahi, spray the bunches with 100 ppm NAA 8 days before harvest.

The yield depends upon the variety, age of the vine and cultural practices adopted. The average yield per acre of different varieties is as follows :

	<i>Per hectare</i>	<i>Per acre</i>
-Bhokari	13,000 kg.-20,000 kg.	5,000 kg.-8,000 kg.
-Bangalore Blue	20,000 kg.-25,000 kg.	8,000 kg.-10,000 kg.
-Anab-e-Shahi	30,000 kg.-37,500 kg.	12,000 kg.-15,000 kg.
-Thompson		
Seedless	15,000 kg.-18,000 kg.	6,000 kg.- 7,000 kg.

## GUAVA

Guava is a delicious tropical fruit and is becoming increasingly popular in the State. It is rich in vitamin C, and is a fair source of calcium and phosphorus. It is used for the preparation of processed products like jams, jellies and nectar.

## SOILS

It grows well on any type of well drained soil. Red loamy soils are ideal for its cultivation.



## CLIMATE

It comes up very well in dry areas receiving a medium rain fall not exceeding 100 cm. In heavy rainfall tracts, plants grow luxuriantly but the quality of the fruit is very poor and insipid and is affected by various pests and diseases. June-July is the best time for planting guava.

## VARIETIES

1. **Allahabad Safeda** : Fruits are round, smooth skinned, white fleshed and with few seeds.

2. **Sardarguava** (Lucknow 49) : The plant is dwarf, spreading and bears fruits profusely. Fruits are large, round, light green with white flesh and few soft seeds.

3. **Navalur** : This is popular in Dharwad district and other areas in northern Karnataka.

## INPUTS

		<i>Per hectare</i>	<i>Per acre</i>		
1. Grafts or layers		270	108		
2. Organic manure (Per plant					
	Farm yard manure or Compost :				
	– Before planting ..	25 kg.			
	– Every year before the application of fertilizers ..	25 kg.			
3. Fertilizers					
	<i>Age</i>	<i>Fertilizer</i>	<i>Per Plant</i>	<i>Per hectare</i>	<i>Per acre</i>
1–3 years		N	50 g.	13.5 kg.	5.4 kg.
		P <sub>2</sub> O <sub>5</sub>	25 g.	5.25 kg.	2.1 kg.
		K <sub>2</sub> O	75 g.	20.25 kg.	8.1 kg.
4–6 years		N	100 g.	27.00 kg.	10.8 kg.
		P <sub>2</sub> O <sub>5</sub>	40 g.	10.75 kg.	4.3 kg.
		K <sub>2</sub> O	75 g.	20.25 kg.	8.1 kg.
7–10 years		N	200 g.	54.00 kg.	21.6 kg.
		P <sub>2</sub> O <sub>5</sub>	80 g.	21.50 kg.	8.6 kg.
		K <sub>2</sub> O	150 g.	40.50 kg.	16.2 kg.
11 years & above		N	300 g.	81.00 kg.	32.4 kg.
		P <sub>2</sub> O <sub>5</sub>	120 g.	24.18 kg.	12.9 kg.
		K <sub>2</sub> O	150 g.	40.5 kg.	16.2 kg.

## CULTIVATION

### PLANTING

Prepare the land by ploughing, and harrowing. Dig pits of 90 cm cube (3 ft.) at 6 mt. (20 ft.) apart. Fill the pits with a mixture of top soil and about 25 kgs of compost. Plant the grafts in the centre of the pit taking care to see that the graft union remains well above the ground level. Stake the plants after planting.

### MANURING AND INTERCULTIVATION

Manure the plants in the beginning of the monsoon and give Protective irrigation at fortnightly intervals which helps to get good yields. Keep the basins of the plants free from weeds. Inter-cropping can be done during first 5-6 years by growing vegetables or other leguminous crops if irrigation facilities exist. Remove the side branches from the trunk upto a height of one metre (3 ft.) from the ground level in the initial years.

### PLANT PROTECTION

**Insects :** Scab Bug (Tea mosquito), Mealy bug, Scales, and Fruit fly.

**Diseases :** Fruit rot and Fruit canker.

#### Schedule

1. Spray the plants at the time of flowering with 20 ml. Malathion or 40 g. Carbaryl or 17 ml. Dimethoate or 10 ml. Oxy Demeton Methyl with 23 g. Zineb in 10 litres of water to control Scab bug and Fruit rot.
2. Repeat the same spray once in 2 weeks if the pest persists.
3. Spray the plants with 10 ml. Malathion or 40 g. Carbaryl with 100 g. Jaggery or Sugar in 10 litres of water when fruits start ripening to control fruit fly.
4. To control fruit rot spray the fruits with 10 ppm Aurofungin and 23 g. Zineb in 10 litres of water.

### HARVESTING AND YIELD

Guava plants start bearing from 3-4 years after planting and economic yields can be obtained from 5 to 6 years onwards.

The guava plants normally flower in three flushes during February (Ambebahar) June (Mrigbahar) and October (Hastabahar).

The number of fruits harvested may vary depending upon the age of the plant. On an average a 10 year old plant may give about 1000 to 1500 fruits per year.

## SAPOTA

Sapota is one of the important tropical fruits, and its area is rapidly increasing in the State.

### SOILS

It grows well on all types of soils. Well drained loamy soils and medium black soils are ideal for its cultivation. Soils with hard rocky substratum or impervious clay are not suitable and should be avoided.

### CLIMATE

Sapota grows both in dry and humid areas. Rainy or cloudy weather at any time of the year does not affect setting of fruits. It can be grown throughout the State. June-July is the ideal period for planting.

### VARIETIES

1. **Kalipatti** : It has dark green leaves and spreading branches. The fruits are oval, the seeds are few and the fruit is mellow and are excellent quality.

2. **Cricket Ball** : Fruits are large and round and the flesh is of moderate quality. It performs well at elevations below 1000 ft. and in relatively arid climate.

3. **Calcutta Round** : Fruits are large, the flesh is gritty and of moderate quality. It is susceptible to 'leaf spot' disease.

### INPUTS

		<i>Per hectare</i>	<i>Per acre</i>
1. Grafts or layers		78-100	27-40
2. Organic manure (Per plant)			
- Before planting	.. 50 kgs		
- Every year	.. 50 kgs		
3. Fertilizers			

		<i>Per plant</i> in g.	<i>Per hectare</i> in kgs	<i>Per acre</i> in kgs
<i>Age</i>				
1-3 years old	N	50	33.75	13.50
	P <sub>2</sub> O <sub>5</sub>	20	13.50	5.40
	K <sub>2</sub> O	75	50.65	20.25



4-6 years old	N	100	67.5	27.00
	P <sub>2</sub> O <sub>5</sub>	40	27.00	10.80
	K <sub>2</sub> O	150	101.30	40.50
7-10 years old	N	200	135.00	54.00
	P <sub>2</sub> O <sub>5</sub>	80	54.00	21.60
	K <sub>2</sub> O	300	202.60	81.00
11 years old and onwards	N	400	270.00	108.00
	P <sub>2</sub> O <sub>5</sub>	160	108.00	43.20
	K <sub>2</sub> O	450	303.90	121.50

## SPACING

	<i>Number of pits</i>	
	<i>Per hectare</i>	<i>Per acre</i>
10m X 10m (33' X 33')	100	40
13m. X 13 m. (40 ft. X 40 ft.)	78	27

## CULTIVATION

### PLANTING

Prepare the land by ploughing, and harrowing. Get pits of one cubic mtr (3'x3'x3') dug at 10m x 10m (33' x 33') or 13 m. X 13 m. (40'x40') apart depending upon the soil. Fill the pits with top soil and compost. Plant the grafts in the middle of of the pit keeping the graft joint above the ground level. Provide support by staking. Keep on removing side shoots from the stock. Protective irrigation during first two summer seasons ensures better establishment of the plants.

### AFTER CARE

Manure the plants in the begining of monsoon. Apply manures and fertilizers 60-90 cm (2-3 ft.) away from the trunk. Weed the plots regularly. Intercropping can be done during the first 7-10 years till the plants cover the entire area. Remove the side shoots upto a height of 90 cm. (3 ft.) on the trunk from the ground level in the initial stages.

### BEARING

Though sapota plants may start flowering and fruiting from the 4th year onwards, economical yields can be obtained only

from 7th year. Though sapota flowers throughout the year, the peak harvest will be in two distinct seasons viz., March to May and September to October. The fruits harvested during summer will be generally sweet.

### **PLANT PROTECTION**

**Major pests :** Fruit borer, Mealybug, Scale insect.

**Major diseases :** Leaf spot, Sooty mould.

#### **Schedule**

Spray the plants with 17 ml. Dimethoate or 20 ml. Malathion with 23 g. Zineb in 10 litres of water whenever incidence of pest and diseases are noticed.

### **HARVESTING AND YIELD**

The fruits will have to be harvested when they develop dull brown potato colour. The average yield per plant of about 10 years old may be around 1,000 to 1,500 fruits.

## **PAPAYA**

Papaya is one of the important quick growing fruit crops. It is nutritious and rich in vitamin A and C. Papain is a valuable enzyme prepared from the latex of papaya.

### **SOILS**

It can be grown on a variety of soils. Well drained medium-black to red loamy soils are quite suitable. Ill-drained, deep black and low lying areas should be avoided.

### **CLIMATE**

It grows well in warm and humid climate. It is very susceptible to water logged conditions and cannot be grown successfully even in heavy rainfall areas. June-July are the ideal months for planting.

### **VARIETIES**

1. **Coorg Honeydew :** The fruits are oblong and have good flavour. It is a high yielding variety. It is a selection from 'Honey Dew' variety. It produces no male plants. The plants are mostly hermaphrodite.

2. **Washington** : Plants are vigorous and stem has purple rings at the nodes. Fruits are round to ovate, medium to large in size. When ripe, skin attains a bright yellow colour. Male and female plants are separate.

3. **Co-1** : Plants are dwarf and fruits are borne within 4 to 5 feet from the ground level. Female and male flowers are born in separate plants. Fruits are medium sized and sweet.

4. **Co-2** : This variety is suitable for extraction of papain.

5. **Solo** : It is another variety introduced in the State recently. The fruits are small and very sweet. A good variety for kitchen garden.

**Selection-7. Red Flesh and Madhu Bindu** are some of the good varieties suitable for cultivation in home gardens.

## INPUTS

		<i>Per hectare</i>	<i>Per acre</i>
1. Seeds		250 g.	100 g.
2. Organic manure			
	Farm yard manure or Compost	25 ton.	10ton
3. Fertilisers	<i>Per plant</i>		
	N	250 g.	425 kgs. 170 kgs.
	P <sub>2</sub> O <sub>5</sub>	250 g.	425 kgs. 170 kgs.
	K <sub>2</sub> O	500 g.	850 kgs. 340 kgs.

## CULTIVATION

### NURSERY

Prepare 2-3 raised beds of 8 m. length, 1.25 m. breadth and 10 cm. height. (25' × 4' 4"). Apply 10-15 kgs of farm yard manure and 1/2 kg. of 15:15:15 mixture per bed and mix it well with the soil. Drench the beds with Cerean wet (2 g. in 1 litre of water) solution. Sow freshly extracted seeds at a depth of 2 cm. in rows with a spacing of 2-5 cm. (one inch) in the row and about 15 cm. (6 inches) between rows. Sowing of seeds during March-April is desirable to facilitate planting in June-July. Provide watering regularly. Provide shade to the young seedlings during summer. Papaya seedlings raised in polythene bags can stand transplanting better than those raised in seed beds. Perforated polythene bags of 22 cm × 14 cm. (9" × 6") with 15 gauge thickness can be used for raising seedlings. Fill the bags with a mixture of manure, soil and sand in equal proportions. Sow two seeds in each bag and retain only one seedling after germination.



## SPACING

	<i>Number of pits</i>	
	<i>Per hectare</i>	<i>Per acre</i>
240 cm X 240 cm (8 ft. X 8 ft.)	1,700	680

## PLANTING

Prepare the land by ploughing and harrowing. Get pits of 0.5 m cube (1.5 ft. cube) dug in 240 cm (8 ft.) rows at 240 cm (8 ft.) apart. Fill the pits with top soil and compost. Plant 1½ to 2 month old seedlings in the centre of the pit. Provide supports. Provide irrigation an an interval of 5—7 days depending upon the soil and weather conditions. Intercrops of vegetables and leguminous crops could be grown during first 6—8 months. Apply the entire quantity of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O in 6 split applications once in 2 months commencing from the second month of planting. Mix the fertilizers well in the soil.

## PLANT PROTECTION

**Diseases :** Anthracnose, Collar rot, Mosaic, Leaf-curl and Powdery mildew.

### Schedule

1. Spray 33 g. Copper oxy chloride in 10 litres of water whenever Anthracnose is noticed.
2. Provide good drainage to check Collar rot.
3. Select seedlings free from Mosaic and Leaf-curl while planting. Rogueout the Mosaic and Leaf-curl affected plants if any, immediately and destroy.
4. Spray 17 g. Oxythioquinox in 10 litres of water to control Powdery mildew.

## HARVESTING AND YIELD

Papaya fruits will be ready for harvest about 9–10 months after planting. Fruits are borne throughout the year. Yield varies from 75 to 100 tonnes per hectare (30–40 tonnes per acre)

The economic life of Papaya Plant is only 3 years. Average yield varies from 30–40 tons per acre.

If it is grown for papain the annual yield of papain varies from 500–750 g. per plant per year.

## POMEGRANATE

Pomegranate is liked for its cool and refreshing juice. In our state it is grown mostly in kitchen gardens. If properly cultivated it can be a highly remunerative crop.

### SOILS

Pomegranate is not exacting in its soil requirements and can be grown on diverse types of soils. It can be grown from sandy loam to heavy loamy soils. It can tolerate slight alkaline conditions. Deep loamy soils are however ideal for its cultivation.

### CLIMATE

Pomegranate requires a cool winter, a hot and dry summer. Better quality fruits are obtained from areas with warm and dry weather during the fruiting season. It is a hardy plant and can withstand considerable amount of drought but thrives well with supplemental irrigation.

### PLANTING SEASON

June-July is ideal time for planting.

### VARIETIES

1. Bassein seedless (Pink arils & soft seeds)
2. Madhugiri

### INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
<b>1. Planting material</b>		
(Air layers or Rooted cuttings)		
5 m × 5 m (15' × 15')	482	193
6 m × 6 m (18' × 18')	335	134
<b>2. Organic manure</b>		
(Farm yard manure or compost)		
- At the time of planting	25 tons	10 tons
- Every year	12.5 tons	5 tons
<b>3. Fertilizers</b>		
- Nitrogen	200 kg.	80 kg.
- P <sub>2</sub> O <sub>5</sub>	300 kg.	120 kg.
- K <sub>2</sub> O	100 kg.	40 kg.

## CULTIVATION

		<i>No. of pits</i>	
		<hr/>	
SPACING :	(a) 5 m. × 5 m. (15 ft. × 15 ft.)	482	193
	(b) 6 m × 6 m. (18 ft. × 18 ft.)	335	134

### PLANTING

Plough the land 2-3 times, harrow and bring it to a fine tilth. Dig pits of 60 cm cube (2' × 2' × 2') depending on the soil type and fertility. Fill the pits with equal quantity of top soil, farmyard manure and red earth. Plant air layers or rooted cuttings in June-July and stake the plants immediately.

### IRRIGATION

The newly set plants need regular irrigation if there is long spell of drought. Once the plants are well established, and after 6-7 months, they can withstand considerable amount of drought. Provide irrigation at an interval of 2 to 4 weeks depending upon the soil, climate and inter-crops grown.

### INTER CROPPING

Grow intercrops like cowpea, cucurbits, cabbage, beans, peas, onions etc., in between rows, for the first 5-6 years.

Grow green manure crops like sunuhemp etc., during monsoon and incorporate the same in the soil. This will improve the texture and fertility of the soils and also improve the bearing.

### MANURING

Regular manuring improves bearing of the tress. Apply the recommended dose of farm yard manure in the basins one metre (3-4 feet) away from the trunk in the beginning of monsoon.

### PRUNING

The pomegranate has a great tendency to produce suckers from the base. These are called as water shoots and suckers. These suckers arise as multiple stems. The suckers grow vigorously without branching and reach the top. They bear a very little crop. The trees with numerous watershoots present a straggly appearance with long weak shoots which bear a few fruits. These suckers may eventually dry up. Hence it is essential that the suckers are removed as soon as they arise. One of the main causes of poor bearing in the commercial orchards is the failure to remove such water shoots and suckers.



The cracking of fruits which is common in pomegranate is mostly due to irregular water supply. This can be minimized by providing protective irrigations whenever there is a long break of rains. The splitting is considerably reduced if windbreaks are planted.

### **PLANT PROTECTION**

**Insects :** Fruit Borer

**Diseases :** Leaf or Fruit spot

#### **Schedule**

1. Cover the fruits with muslin cloth bags wherever possible.
2. Remove and destroy infected fruits.
3. Spray 10 ml. Malathion or 40 g. Carbaryl with 23 g. Zineb in 10 litres of water at the time of flowering and repeat at intervals of 3 weeks till fruits are harvested.

### **HARVESTING AND YIELD**

The trees start yielding from 4th year onwards giving 20-25 fruits/tree. Crop increases progressively and in the 10th year a tree may give 100-150 fruits per year. The average yield in well managed gardens may be as much as 200-250 fruits per tree. Economic yields are obtained upto an age of 25-30 years.

---

## **PINEAPPLE**

Pineapple is a delicious tropical fruit. Its area in the state is fast increasing. The fruit is juicy, sweet and pleasantly flavoured. It has a very high nutritive value being a rich source of vitamins A, B and C and several minerals.

### **SOILS**

Pineapple comes up well in all types of soils except on very heavy clay soils, provided there is good supply of water, proper drainage and soil aeration. Light soils are ideal for pineapple growing. Low lying areas with high water table should be avoided.

### **CLIMATE**

Pineapple grows well in warm humid climate. The plants can be grown under wide range of rain fall, conditions extending from 60 to 400 cm. annually. June is the best month for planting pineapple.

## VARIETIES

1. **Kew** : Kew is the most suitable variety for canning purposes. It has spines only at the tip. It bears big fruits (1.5 to 2.5 kg.)

2. **Queen** : It is a good table variety. It produces small fruits with very good taste. The plant has spiny leaves and bears fruits weighing 0.5 to 1.00 kg.

## INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
1. <b>Planting material</b> (Suckers or slips)	45000	18000
2. <b>Organic manure</b> (Farm yard manure or Compost.)	30 tons	12 tons
3. <b>Fertilizers</b>		
N	350 kgs.	140 kgs.
P <sub>2</sub> O <sub>5</sub>	130 kgs.	52 kgs.
K <sub>2</sub> O	438 kgs.	175 kgs.

## PLANTING MATERIAL

Suckers, slips and crowns are the important types of material used for planting. Suckers arise from the axil of the leaves and the slips are found on the fruit stem. Suckers and slips should be preferred for planting as they come to bearing earlier than the crown producing better fruits.

Too large suckers or slips are not good for planting. Planting material should not be heaped, instead they can be arranged upside down under shade. The small brown basal leaf should be removed and basal portion treated with insecticide and fungicide before planting to control mealy bug and stem rot.

## CULTIVATION

### PLANTING

Plough the land 2-3 times, harrow and bring it to a fine tilth. Dig 90 cm. (3 ft.) wide trenches of 15-22 cm. (6" to 9") depth at 60 cm. (2 ft.) apart. Put the excavated soil in the trench.

Form trenches and ridges. Put the top soil in the bottom of the trenches and mix with farm yard manure. The popular method of planting pineapple is the double row system. The two rows are spaced 60 cm (2 ft) apart and in each row the plants are planted 30 cm. (1 ft.) apart diagonally. If necessary, make holes with crow-bar to keep the plant firm. Avoid soil getting into the heart of the plant. Provide irrigation after planting.

### INTERCULTIVATION

Fertilizer application, weeding, earthing up and irrigation are the important intercultural operations. Give fertilizers in split

doses. Give the first dose after 3 months of planting. Apply phosphatic fertilizers at the time of planting. Give the other fertilizers at four quarterly intervals. After each fertilizer application earth up to help the plants to ensure good support and root development. To control weeds and conserve moisture, mulching can be done with dry leaves. Provide irrigation in summer months once in 15 days or 20 days depending on the soil type.

### **USE OF GROWTH REGULATORS**

When the pineapple plants are 13-14 months old or 37-38 leaf stage after planting, treat the plants with growth regulators like Naphthaline acetic acid (10 ppm) with 2 percent urea or Ethephon alone at 100 ppm or a mixture of 25 ppm Ethephon with 2% urea and 0.04 percent Sodiumm Carbonate. The mixture is to be poured into the heart of the plant at 50 ml. per plant. After the growth regulator treatment, the plants will take 40-45 days to put forth the inflorescence. The problem of erratic flowering can be solved by growth regulator treatment. For increasing fruit size apply 200 ppm NAA 2-3 months after fruit set.

### **PLANT PROTECTION**

**Insects :** Mealy bugs.

**Diseases :** Wilt, and Heart rot.

#### **Schedule**

- (1) Remove the basal and decaying brownish leaves of the suckers at planting.
- (2) Dip the suckers in 10 ml. methyl parathion or 17 ml. Dimethioate in 10 litres of water before planting.
- (3) Apply 7 kg. phorate per acre if Mealy bugs are observed.
- (4) Repeat 'Phorate' application 100 days later if Mealy bugs are still noticed.
- (5) Spray the crop with 20 g. Difolatan in 10 litres of water or 23 g. Zineb in 10 litres of water to control Heart rot.
- (6) Select disease free suckers from disease free areas to control of Wilt.

### **WEED CONTROL**

Hariyali and nutgrass are the common weeds in pineapple plantations. Follow hand weeding once a month. Use of weedicides is becoming popular. spray 2 kg. a.i. Bromacil and 2 kg. a.i. Diuron Per ha dissolved in 900 litres of water at the time of planting suckers. This will control all kinds of weeds for 9-15 months in sandy loam soils.



## FRUIT DEVELOPMENT AND HARVEST

The plant gives out inflorescence generally after 12 months and it takes  $4\frac{1}{2}$  to  $5\frac{1}{2}$  months for the fruit to mature and ripe. For purposes of canning, harvest the fruits when the fruit starts changing colour. But for table purposes, the fruit could be retained till it develops satisfactory colour. Harvest the fruit by cutting with knife retaining 2-4 cm. (1-1.5") long peduncle. The fruit after harvest, can be kept with the crown for 3-4 weeks.

---

## COCONUT

Coconut is one of the major commercial crops of the State which not only supplies food, drink, and shelter but also provides raw material for a number of industries. It contains fat and also some vitamins counter balancing some of the deficiencies of some starchy foods.

### SOILS

Coconut can be grown on a variety of soils. Well drained deep sandy loam, alluvial and red loamy soils are ideal for its cultivation. Heavy clay soils and water logged areas should however be avoided.

### CLIMATE

Coconut is a tropical crop and grows well in warm humid areas with altitude ranging from sea level to 1000 m. (3000 ft.). It can be successfully grown in interior areas on rolling lands with well distributed rain fall of about 750 mm (30") per year.

### VARIETIES

(a) **Tall varieties** : e.g. West Coast tall, Arsikere tall (Tiptur Tall). These varieties are hardy and tolerant to diversified soils and climatic conditions. Normally start yielding from 7-8 years after planting. Yields about 60-80 nuts per palm with good copra and oil content. Some of the other promising tall varieties are Laccadive ordinary, Andaman ordinary, Java Giant etc.

(b) **Dwarf varieties** : e.g. Gangabodham, Laccadive dwarf, Chowghat dwarf orange, Malayan dwarf orange etc. These are short in stature and normally start flowering

in 3-4 years. They grow rapidly and bear heavily, but there is a tendency of irregular bearing.

(c) **Hybrid varieties :** Tall  $\times$  Dwarf (T  $\times$  D) Dwarf  $\times$  tall (D  $\times$  T) and Natural cross dwarf (NCD) hybrids are gaining popularity because of their early bearing and high productivity. They are medium dwarf in stature and start yielding from 3-4 years after planting.

## INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
<b>1. No. of seedlings</b>		
For tall varieties 9 m. $\times$ 9 m. (27' $\times$ 27')	150	60
For dwarf and 7.5 m. $\times$ 7.5 m. hybrid varieties (25' $\times$ 25')	173	69
<b>2. Organic manures</b>		
(a) Farm yard manure or compost	12.5 tons	5 tons
– Before planting	50 kg. per palm	per year
– Every year		
(b) Green leaves		
– Every year	50 kg. per palm	Per year
<b>3. Fertilizers</b>		

### *Per palm in grams*

	<i>Premonsoon</i> (May-June)			<i>Post-monsoon</i> (Octr.-Novr.)		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
3 months after planting	—	—	—	50	30	120
1 year after planting	60	40	140	110	70	260
2 years after planting	120	80	280	220	140	520
3 years onwards	180	120	420	330	210	780

## CULTIVATION

### RAISING OF HEALTHY SEEDLINGS

1. Select healthy, high yielding and regularly bearing (more than 100 nuts) palms of 25-50 years of age from reputed gardens for selecting the seed nuts.

2. Select fully matured medium sized nuts with little quantity of water.
3. Select seed nuts only from October to March harvests which are good.
4. Prepare seed beds of 8 m.  $\times$  150 cm  $\times$  23 cm (25 ft.  $\times$  5 ft.  $\times$  9" inch) and fill with sand after digging the area to a depth of about 45 cm. (18 inches).
5. Select seednuts with minimum water content.
6. Plant seed nuts in time during May-June at one foot apart in the beds horizontally.
7. Seed nuts take 4-5 months to germinate and will be ready for planting in about a year. Reject seedlings which germinate 6 months after sowing.
8. Select quality seedlings with vigorous growth good girth at the collar, short thick petioles, large number of roots and early splitting leaves.

Apply pre-monsoon dose of fertilizers after giving a basal dose of 50 kg. green leaves and 50 kg. compost per palm in the basin.

### PLANTING

1. Prepare the land by ploughing and harrowing.
2. Get pits of 1 ms. (3 ft.) cube dug maintaining the distance according to the variety.
3. Fill the pits with green leaves and top soil and plant seedlings and provide supports.
4. Provide partial shade during summer.
5. Deep planting upto 45 cm. (18 inches) has many advantages.
6. Apply heptachlor 6% dust while planting for controlling termites.

### INTERCULTIVATION

Plough the area in between, once or twice every year. Provide irrigation during summer. Grow crops like cereals, vegetables or leguminous crops or pineapple or banana as intercrops for few years. After 15 years, cocoa, mulberry, Banana and Pineapple can be grown.

### PLANT PROTECTION

**Insects :** Rhinoceros beetle, Leaf eating caterpillar (Hephantis Serenopa), Red palm weevil and Root grub.

**Diseases :** Stem bleeding, Anabe roga, Bud rot and Leaf spot (Pesulotia)



### Schedule

1. To control Rhinoceros beetle, remove the adult beetles from the infected fronds with the help of pointed recurved hook and fill the hole with BHC 10% or DDT dust and fine sand mixed in 1:1 proportion.
2. Remove and burn of affected leaflets and spray of the plants with 40 gm. Carbaryl in 10 litres of water. This will reduce the damage of leaf eating caterpillar.

OR

Inject the stems of 20 years and above, tall coconut palms after harvesting the standing coconuts crop, with 17 ml. Monocrotophos directly into the hole made at 3 depth on the stem just 3 feet above the ground level with an auger.

OR

Contact the State Department of Horticulture for release of parasites for the control of Leaf eating caterpillar.

3. Application of Pyrocone E about 1-1½ litre per plant after opening a hole at the site of entrance of the grub with a bent funnel controls the red palm weevil.
4. Before the first monsoon rains, apply Aldrin, Dieldrin or Chloradane dust at the rate of 50 g. per plant around the stem in about 1 m. radius (5 ft.) and mix it well in the soil to control root grubs.
5. Stem bleeding could be checked by scrapping the affected portion with a chisel till the healthy portion is exposed and pasting the area with boardaux paste.
6. Anabe roga being a soil borne disease, is difficult to control its further spread, can be checked by removing severely affected palms along with the roots from the garden and applying 1 kg. Mancozeb or Captan or Thiram in deep trench 1 m. (3 ft.) away from the base of the plants of the affected and neighbouring palms.
7. Budrot can be checked by cutting the top leafy portion carefully, clearing the tissue and spraying with bordaux mixture.
8. Leaf spot disease can be effectively controlled by spraying 23 g. Zineb in 10 litres of water whenever noticed.

### HARVESTING AND YIELD

Coconut palms start yielding from 6-7 years after planting. Dwarf varieties and Hybrids start bearing in about 4-5 years.

Coconuts may be harvested throughout the year as and when they mature. The main harvesting season however is summer and the peak harvesting period is April-May.

Average yield is about 80-100 nuts per plant per year.

## ARECANUT

Arecanut (Betelnut) is an important plantation crop of the State. Chewing arecanut is said to have a toning effect on the body and it is expected to have nerve stimulating and vermifugal properties. The extracts on boiling the nuts contain tannin, which could be used for tanning leather. It also contains a few alkaloids, which have medicinal value.

### SOIL

Red loam, lateritic loam or alluvial loam with adequate drainage is suitable for arecanut crop. Avoid heavy, alkaline or water logged soils.

### CLIMATE

The major arecanut growing belt is confined to the regions of high rainfall including western ghats and malnad. It is a humid tropical palm and comes up well with rainfall ranging from 200-375 cm. (80 to 150") and temperatures ranging from 15°C to 50° C. It is also possible to grow arecanut in regions of lesser rainfall where the temperature is not high, under copious irrigation. It can be successfully cultivated from about 80 m. (250 ft.) to 1000 m. (3000 ft.) from sea level. May-June are the best months for planting in low rain fall areas and September-October in heavy rainfall areas

### VARIETIES

Indigenous tall types are commonly grown. A few exotic types, introduced at Central Plantation Crops Research Institute, Vittal are promising. Among them 'Mangal' is important.

### INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
1. Number of seedlings		
- 2.7 m.×2.7 m. (8'×8')	1700	680
- 4.0 m.×4.0 m. (12'×12')	755	302

## 2. Farm Yard manure or Compost

- For nursery beds 25 tons 10 tons
- After transplanting to be given 20 kgs per plant - apply every year during pre-monsoon (May June).

## 3. Fertilizers

	<i>Per plant in grams</i>		
	<i>Pre-monsoon (May-June)</i>	<i>Post-monsoon (Septr.- October)</i>	<i>Total</i>
Nitrogen	35	65	100
P <sub>2</sub> O <sub>5</sub>	13	27	40
K <sub>2</sub> O	45	95	140

*Note :* Apply 1/3 of the above dose for one year old plants and 2/3 of the above dose for two year old plants and full dose for three year old and above.

## CULTIVATION

### NURSERY

(a) **Selection of mother palms :** The mother palms should be selected from disease free, best yielding gardens of the locality. The palms should be middle aged (20-40 years), healthy and with a robust crown. Select medium sized seed arecanuts, from middle bunches, of selected palms. All nuts that are undersized, malformed or from the tips of the bunches should be avoided for the seed purposes.

(b) **Primary nursery :** Sow the selected seednuts in seed beds immediately after harvest and not later than 8 days after harvest. Germination trenches or beds should be in a shady place. Dig trenches of 30 cm. (12 inches) depth and convenient length and breadth and fill the same with top soil and sand. Sow the seeds with their stock and pointing upwards in the sand bed giving a spacing of 2.5 cm. × 2.5 cm. (1" × 1") and covered with sand just to cover the seeds. Irrigate the beds daily, Nuts begin to germinate 30-40 days after sowing.

(c) **Secondary nursery :** About 3 months after sowing, plant the sprouts with 2 or 3 leaves in the secondary nursery beds. Plough or dig the nursery area and prepare raised beds of 15 cm. (6") height 120 cm. (4 ft.) width and convenient length with irrigation channels in between the beds in North-South direction. Apply



25 tons farmyard manure per hectare of nursery area (10 tons per acre). Provide shade by planting banana well in advance in between the beds, alternating with irrigation channels or sow *Sesbania Egyptica*. Transplant the seedlings in these beds at a distance of 30 cm. (12 inches) apart. Give top mulching once or twice and manure with 25 kg. N/hectare (10 kg. N per acre) for better growth.

### PREPARATION OF LAND AND PLANTING

Prepare the land by ploughing, harrowing and levelling. Provide good perennial shade on the western and southern borders by planting jack, neem ; casurina or pongamia. Get pits of 90 cm cube (3 ft.) dug at a spacing of 2.7m×2.7m. (8'×8') or 4.0 x 4.0 Mt (12'×12') with one seedling in the centre. Fill the pits with top soil mixed with compost and plant seedlings in the centre of the pit 7.5 cm. to 15 cm. (3" to 6") below the ground level to facilitate watering.

### INTERCULTURE

Intercultivate gardens regularly to remove weeds. Clear the drains of weeds and deepen before the onset of South-West monsoon. Irrigate the palms during summer months at regular intervals of 4-6 days depending upon the soil type. Grow green manure crops on the onset of monsoon which will suppress weed growth, prevent soil erosion and add large quantities of organic matter to the soil.

Banana, Cocoa (in Westcoast), pepper, betel-vine, cardamom (in Malnad), Guinea grass, pineapple or yam could be grown as inter crops wherever possible with advantage.

### PLANT PROTECTION

**Major pests :** Mite, Spindle bug, Inflorescence-Caterpillar and Root grub.

**Major diseases :** Koleroga or Fruit rot, Budrot, Hindimundige roga and splitting of the stem.

#### Schedule

1. Spray 10 ml. Dicofol or 14 ml Carbophenothion in 10 litres of water to control mites. Repeat the spray once in two weeks whenever there is infestation.
2. Spray 20 ml. Endosulfan in 10 litres of water whenever Spindle bug and Inflorescence caterpillars are noticed.
3. Koleroga (Fruitrot) and Budrot can be checked by spraying with 1% Bordeaux mixture or 33 g. Copper oxychloride in 10 litres of water as a prophylactic spray just before the commencement of monsoon. Cut the top leafy portion

carefully, clean the tissue, and spray bordaux mixture for effectively controlling bud-rot.

### HARVESTING AND YIELD

Generally arecanut is harvested from November to March. In plains and to some extent in Malnad areas tender nuts are cured by cutting the kernel, boiling and drying them. In South Kanara and in parts of North Kanara, Shimoga and Coorg districts, riped arecanuts are dried to prepare 'Chali'.

The normal yield of tender cured kernel would be 1250 kg per ha (500 kg per acre) and Chali would be about 2,000 kg. per hectare (800 kg. per acre).

## CASHEWNUT

Cashew is an important dollar earning crop of India. Cashew kernals form a delicious snack item and are used in various confectionaries. Cashew apple juice is rich in carbohydrate, ascorbic acid, protein and minerals. It is used in the preparation of syrup, juice and cashew fenny. Cashew shell oil is used as an industrial raw material.

### SOIL

Being a hardy crop, it can be grown in a wide range of soils, except heavy clay and saline soils. It comes up well in deep loam with adequate drainage facilities.

### CLIMATE

Cashew comes up well under hot and humid climate of the west coast. It can also be grown in other regions upto 750 m. (2500 ft.) above sea level receiving an annual rainfall of 500 to 3750 mm. It is very sensitive to low temperatures. June-July is the ideal time for planting.

### INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
<b>1. Planting materials</b> (Seedlings or airlayers)		
8 m. × 8 m. (25 ft. × 25 ft.)	173	69
<b>2. Farmyard manure or Compost</b>		
(before planting)	2.5 tons	1 ton

### 3. Fertilizers

Age	Per plant in g.		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
- Below 3 years	40	50	40
- Between 3-6 years	80	100	80
- Above 6 years	120	150	120

## CULTIVATION

### PROPOGATION

1. **Seedlings** : Cashew plantations are usually raised from seedlings raised in polythene bags. Sow the seeds in polythene bags 15 cm. × 20 cm. (6" x 8") with stalk pointing upwards. The seedlings will be ready for planting in 2 to 3 months.

2. **Air layers** : Uniform and high yields can be obtained if airlayers from high yielding selected tress are used. For the preparation of air layers, February-April is the best period. Air layers will be ready for planting in June.

### PREPARATION OF LAND AND PLANTING

Prepare the land and dig 60 cms cube (2 ft.) pits at 8 m. (25 ft.) apart and fill with top soil and 10-15 kg. organic manure per pit. Plant the seedlings/air layers in the centre of the pit during monsoon. Apply fertilizers as per recommended dosage in the months of September-October after the heavy rains are over. This would improve the yields considerably.

In the early years of planting, intercrops like pineapple, chillies, ginger, pulses and ragi etc., could be grown to get some income till the plants come to bearing.

### PLANT PROTECTION

**Insects** : Stem borer, Leaf miner and Tea mosquito.

**Diseases** : Die back

#### Schedule

1. To control Cashew stem borer squab the stem with 0.17 BHC 50 % or drench the stem after removing the affected tissues along with immature stages of the pest, if the infestation is detected in the early stages. Also remove the dried twigs and branches.

OR



Insert one aluminium phosphide tablet and seal the holes with wet soil.

2. Spray 5 ml. Phosphomidon or 10 ml. Manocrotophos or 17 ml. Dimethoate or 10 ml. Fenthothion with 33 gm. copper oxychloride in 10 litres of water four times at an interval of 2-3 weeks starting from middle of October coinciding with new flush.

Give a similar spray in May-June after pruning the deadwood to control Die back disease and insects.

## CARDAMOM

Cardamom is a perennial herbaceous plant requiring shade. It cannot stand direct sunlight.

### SOILS

Well drained rich forest loams and red, deep light textured laterite soils having plenty of humus are good for the crop.

### CLIMATE

The crop thrives well in evergreen tropical forests with an altitude of 760 m. to 1520 m. (2500 to 5000 ft.) and a well distributed annual rainfall of 150 to 635 cm. (60 to 250 inches) and a temperature range of 32° C (50° to 90° F). Humid moist (but not waterlogged) situation and eastern, or south eastern slopes are favourable for the crop. It grows well in areas protected from strong winds. First fortnight of June or August is the ideal time for planting.

### VARIETIES

Mysore, Manzarabad, Malabar and Vazukka are popular varieties in the State.

### INPUTS

	<i>Per hectare</i>	<i>Per acre</i>
<b>1. Seedlings or Suckers.</b>		
– 3 m. × 3 m. (9' × 9')	1343	537
– 2 m. × 2 m. (6' × 6')	3025	1210

**2. Farmyard manure or compost**

- Before planting 20 kg./pit
- After planting every year 10 kg./plant

**3. Fertilizers**

Nitrogen	75 kg.	30 kg.
P <sub>2</sub> O <sub>5</sub>	75 kg.	30 kg.
K <sub>2</sub> O	150 kg.	60 kg.

**CULTIVATION**

**PROPAGATION :** Through seeds and suckers.

**NURSERY**

Prepare beds of size 1 m. × 5 m. (3' × 15' × 12") with about 30 cm. height. Spread a layer of humus rich forest soil over the beds. Treat the seed bed with Formalin one week before sowing seeds. and cover the bed with canvas for 1 to 2 days to allow the fumes to act. About 400 g. Formalin dust is sufficient to cover an area of 1 sq. metre. (To prepare Formalin dust, mix thoroughly 15 ml. Formaldehyde with 85 g. of finely powdered soil).

About a week after the treatment, sow seeds in lines 12 cm. apart (5 inches) at 5 g. per square metre of the bed. Cover the seeds with a thin layer of sand or soil and spread a layer of paddy straw or any other suitable material as a mulch. Water regularly every day. When the seeds germinate after 3 to 4 weeks, provide shade to the beds to protect the seedlings from sunlight.

**DIGGING OF PITS**

Dig pits of size 60 cm. × 60 cm. × 45 cm. (2' × 2' × 18"). Fill them with mixture of surface soil and compost or well decomposed cattle manure. Use 3 m. × 3 m. spacing for Mysore variety and 2 m. × 1 m. spacing for Malabar and Vazukka varieties.

Remove the seedlings from the nursery with a ball of earth with as little disturbance to the roots as possible and plant in the centre of the pit.

**AFTER CARE**

**Weeding :** Remove weeds as and when they appear.

**Trashing :** Remove old drying shoots and leaves once a year in May-June.

**Shade Regulation :** Regulate the shade in June by removing some branches which do not allow light to come in.

**Manuring :** Apply 30 kg. N. 30 kg.  $P_2O_5$  and 60 kg.  $K_2O$  per acre. Also apply well decomposed farmyard manure or leaf mould at 10 kg. per plant prior to the application of fertilizers.

Apply fertilizers in two equal split doses first in May-June and the Second in September-October.

### EXPOSING PANICLES

From April onwards, keep the panicles exposed by periodical removal of dry leaves. The flowers must be exposed to allow the honey bees to pollinate.

### PLANT PROTECTION

**Insects :** Hairy Caterpillar, Thrips, Shoot borer, Capsule borer and Aphids.

**Diseases :** Katte or Marble disease, Clump rot, Leaf spot and Damping off.

### Schedule

1. Control Katte disease of Cardamom by following the measures suggested below :
  - (a) Mark the "Katte" affected plants.
  - (b) Spray 5 ml. phosphamidon or 10 ml. Dimethoate in 10 litres of water.
  - (c) Three days after spraying dig out these plants along with rhizomes and destroy them. While removing the plants the individual pseudostem should be firmly held in a grip at the base and pulled upwards to kill any aphids, present in between leaf sheaths. The uprooted plants should be carried only in gunny bags.
  - (d) Remove all the Arnumomum and Asphinia species of weed which acts as alternative hosts which carry virus.
2. Spray the crop with 1 % Boraux mixture of 33 g copper oxychloride in 10 litres of water whenever the symptoms of Leaf spot disease are noticed.
3. Treat the seed bed with 1:50 formalin before sowing. Also spray the seedlings with 33 g. Copper oxychloride in 10 litres of water 2-3 times at an interval of 10-15 days.
4. Spray the crop with 45 g. D.D.T. 50 % or 20 ml. Quinalphos, or 40 gm. Carbaryl in 10 litres of water whenever the incidence of Hairy caterpillar or shoot borer is noticed.



## HARVESTING AND YIELD

Harvesting starts from August and continues upto January.

The average yield varies from 60 to 250 kg. per hectare (24 to 100 kg./acre).

## PROCESSING

Dip freshly harvested cardamom capsules in 2% washing soda solution for 10 minutes and then spread them for drying in sun or in specially built drying chamber or dehydrator. Roll the dry capsules in a wire mesh drum or shake them in gunny bags with few small stones and winnow to remove other plant residues and foreign matter. Grade and keep in gunny bags with polythene lining.

---

## BLACK PEPPER

Pepper is an evergreen climbing and trailing plant, needing some support to climb. Black pepper is the dried fruit. White pepper is the same ripe fruit deprived of its tender skin.

## SOILS

Fertile, friable, well drained loams, rich in humus or red laterite virgin soils, on hill slopes and flat lands are suitable for pepper cultivation.

## CLIMATE

It is a tropical crop requiring warm and humid weather. An annual rainfall of 625 cm. (250") and above and a temperature ranging from 10° to 39° C (50° to 100° F) is ideal. The crop needs partial shade. The best period for planting is August particularly after the heavy rains are over.

## VARIETIES

- |                    |                           |
|--------------------|---------------------------|
| 1. Bilemalligesara | 5. Uddakare               |
| 2. Karemalligesara | 6. Motakare               |
| 3. Karekodathukare | 7. Kaluvalli              |
| 4. Doddiga         | 8. Panniyur hybrid No. 1. |

**INPUTS**

	<i>Per hectare</i>	<i>Per acre</i>
1. <b>Planting Material Cuttings with Eour Nodles</b>		
-2.5 mt.×2.5 mt. (8 ft.×8 ft.)	1700	680
-3.6 mt.×3.6 mt. (12 ft.×12 ft.)	755	302
2. <b>Farmyard Manure or Compost</b>	10 kg. per plant every	
3. <b>Fertilizers:</b>	year.	
	Per vine/gms.	
Nitrogen	20 g.	
Castor cake	500 g.	
P <sub>2</sub> O <sub>5</sub>	25 g.	
K <sub>2</sub> O	90 g.	

**CULTIVATION****SUPPORTING TREES**

Areca palms, Erythrina Indica, and other shade trees in Coffee plantations.

**Spacing of Supporting trees :** 8'×8' to 12'×12'  
(2.5 m×2.5 m to 3.6m×3.6 m.)

**PROPAGATION**

Cuttings with four nodes obtained from the middle portion of long shoots are used for planting.

**PLANTING**

Plant the cuttings on the eastern side about 60 cms. (2 ft.) away from the base of the supporting tree.

Apply 10 kg. farmyard manure or compost along with the suggested dosage of fertilizers in May or June.

**CULTURAL PRACTICES**

Dig the soil round the vines in May-June before manuring. Tie the shoots to supporting trees regularly. Cover the base of the vine with a mulch of dry leaves or grass, particularly during summer. This is essential to conserve moisture.

**PLANT PROTECTION**

**Insects :** Flea beetle and scale

**Diseases :** Anthracnose and Black rot.

**Schedule :**

1. Spray the crop with 0.5% Bandaux mixture or any copper fungicide during monsoon to control Anthracnose.
2. Remove and burn all the disease affected parts and burn them. Also treat the pits with 1% Bandaux mixture before planting. This will control Black rot to a great extent.
3. Spray the crop with 50 g. DDT 50% in 10 litres of water to control flea beetle.
4. Spray the crop with 10 ml. methyl parathion in 10 litres. of water whenever the incidence of pepper scale is noticed

**YIELD**

Each plant will yield about 1.5 kg. from 8th year onwards.

---

Instructor in Entomology  
College of Agriculture  
Hebbal, Bangalore-560024.



# COMPATIBILITY CHART OF PLANT PROTECTION CHEMICALS

## KEY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Lime Sulphur	Wettable Sulphur	Captan	Organo mercurials	Zineb, Thiram Ziram, Maneb	Fixed Coppers	Bordeaux	Sevin (Carbaryl)	Rogor (Dimethoate)	Dinocron (Phosphomedon)	Diazinon	Malathion	Systox Metarystox Schradan (OMPA)	Ethyl Parathion Methyl Parathion	Endrin, Aldrin Heptachlor Chlordane	BIIC, Lindane	D.D.T.	

D.D.T.	+	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	1. Not usually mixed together or compatibility not known.
BHC, Lindane	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2. When mixed with water, decomposes after standing. With a Ziram mixture, adding 1 pound skim milk to 100 gallons of spray solution may prevent decomposition.
Aldrin, Heptachlor, Chlordane	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	4. Not recommended, except as directed by manufacturer. Presence of Calcium compound may change residual fungicidal nature of Dithiocarbamates to eradicant type without residual action.
Ethyl Parathion, Methyl Parathion	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	4. Bordeaux may be used with Guignon or Parathion on grapes with caution No. 2.
Methyl Parathion	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	5. Use wettable powder forms only.
Systox, Metarystox Schradan (OMPA)	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	6. Combinations of Sevin & Malathion may cause injury to cotton.
Malathion	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Diazinon	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Dinocron	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Phosphomedon	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Rogor (Dimethoate)	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Sevin (Carbaryl)	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Bordeaux	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Fixed coppers	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Zineb, Thiram, Maneb, Ziram	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Organo mercurials	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Captan	—	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Wettable Sulphur	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	
Lime Sulphur	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	

++ = Safe

+ = Caution

— = Incompatible

## COMPATIBILITY CHART OF PLANT PROTECTION CHEMICALS

This hart has been prepared based on the spray compatibility chart of 1968 published by Meister Publishing Co., Willoughby, Ohio. Certain solvents and emulsifying agents may change the compat b lity of some of these chemicals. The spray compatibility indicated herein refers to chemical, physical and phytologic compatibility and is not intended to refer to residues or residue tolerances. The information provided is only an aid to preliminary planning but in the actual application of sprays and use of other chemicals and other materials, exclusive reliance should be placed on the directions and information supplied by the manufacturers.

**Antibiotics :** Although most effective when used alone. Streptomycin and Agrimycin may be combined safely with Aldrin, Arsenate of lead, Captan, Fixed coppers, DDT, Parathion, Wettable sulphur, Maneb and Zineb. Do not combine with B. H. C. or Chlordance. Do not combine with Bordeaux mixture or other materials with an alkaline reaction.

**Urea :** Generally compatible except for caution with Lime Sulphur and Sevin.

**Nutrient Sprays :** Nutrient sprays containing Boron, Magnesium, Manganese, Iron, Zinc and Urea should be applied separately unless compatibility is known.

---

## PESTICIDES-THEIR COMMON AND TRADE NAMES

<i>Common names</i>	<i>Trade names</i>
1. Aldrin	.. Aldrin, Aldrex, Gopaldrin, Hexamaldrin, Aldrin Sandoz, Micoaldrin, Lethalrock aldrin, Alstan.
2. Aluminium Phosphide	.. Phostaxin, Celphos, Hexamar Aluminium phosphide.
3. Anticoagulants	.. Ratafin, Warfarin.
4. Antibiotics	.. Streptocycline, Kusumin, Aurofungin, Agrimycin.
5. B. H. C.	Gamaxane, Hexachlor, Benzi-chlor Benzex, Hexidol, Hexmar B. H. C. Intox B. H. C., Mico-sane, Letholrock B. H. C. Vegfru B. H. C. Benzin.
6. Carbophenthion	.. Trithion, Hexathion.
7. Carbaryl	.. Sevin, Hexavin, Carbaryl Sandoz, Carvint, Killex Carbaryl, stanryl.
8. Captan	.. Captan
9. Chlordane	.. Hexamar Chlordane, Mico-chlordane, Intox Chlordane, Letholrock Chlordane, Chloro-tox, Klordex
10. Chlorophyriphos	.. Dursban
11. Chlordimeform	.. Galecron
12. Chlorfenvinphos	
13. Copper oxy-chloride	.. Blitox, Fytolon, Cupramar, Copex, Kirthi copper, Shell copper, Micop, Anrucop, Cup-rokylt, Bluecopper 50, Cupravit, Blimix, Parrycop, Vegcop, Fucop.
14. Cuprous Oxide	.. Copper sandoz dust, Coppesan, Fungimar, Fytomix.
15. D. D. T.	.. Lotexdit, Didimac, Guesarol, Hexamar D. D. T., Intox D. D. T., Letholrock, Neocid, Vegfru D. D. T, Esdit.



16. Dimethoate	.. Rogor, Cygon, Hexagor Dime- tox, Digor.
17. Dichlorivas	.. D. D. V. P. Nuvan, Marvex Divap, Stanvos.
18. Dieldrin	.. Dieldrin, Dieldrex, Gopdiel- rex, Hexamar Deldrin, Letholrock Diedrin, Micodio- drin.
19. Diazinon	.. Basudin
20. Disulfoton (Thio-demeton)	.. Silvirex, Disyton, Systox, Surkil
21. Dicofol	.. Kelthane, Hexakel.
22. Dinacop W. P.	.. Karathane.
23. Endosulfan	.. Thiodan, Hexasulfan, Esdan.
24. E. D. B. Ampules	.. E. D. B. Ampules, Celmid.
25. Fenitrothion	.. Sumathion, Accothion, Foli- thion Fenitox, Hexafen, Stan- thion.
26. Formothion	.. Anthio, Ekatin-M.
27. Fenthion	.. Lebaycid
28. Ferbam	.. Ferbam, Hexaferb.
29. Furadon	.. Carbofuran
30. Heptachlor	.. Mico Heptachlor, Hexamar Heptachlor, Heptaf, Hetopox, Heptan.
31. Hinosan	.. Hinosan
32. Lindane	.. Lindane, Hexamar Lindane, Lintox, Linstan.
33. Malathion	.. Mico Malathion, Malathion, Sandox Meltex, Letholrock Malathion, Malamar, Malatox, Cynthion, Malstan.
34. Maneb	.. Dithane-M-22
35. Mancozeb	.. Dithane M-45
36. Menazon	.. Syfox.
37. Methyl Parathion	.. Paramar, Ekatox, Thiophos; Micoparathion, Paratex, Paratox, Metacid.
38. Monocrotophos	.. Nuvacron.
39. Organo-mercurial compounds :	
(i) Phenyl Mercury acetate	.. Ceresan dry

(ii) Methoxy Ethyl chloride	.. Ceresan wet
(iii) Phenyl mercuric acetate Plus Ethyl mercury Chloride	.. Agrosan G. N., Hexason
(iv) Methoxy ethyl	.. Aretan.
(v) Mercury Chloride	.. Tafsan, Agallol, Seedrex, Tillox, Shell Seed dresser.
40. Oxydemeton-methyl or Demeton-methyl	.. Metasystox, Hexasystox.
41. Oxythioquinox	.. Morestan.
42. Penthoate	.. Phendal
43. Phosphamidon	.. Dimecron
44. Phorate	.. Thimet, Hexamorphorate
45. Phosalone	.. Zolone
46. Quinalphos	.. Ekalux, Ekalux G-5.
47. Sulphur dust	.. Sulphur dust
48. Thiram	.. Thiram, Hexathin, Thirade
49. Thiometon	.. Ekatin, Hexatin
50. Trichlorfon (Trichlorphon)	Diptrex.
51. Wettable Sulphur	.. Cosan, Mico wettable sulphur, Thiovit, Microsul, Sulkul, Sultaf Hexasul, Solbar, Spersul, Spitox, Sulfex, Vegsulf, Stanvit.
52. Zineb	.. Dithane Z-78, Hexathane, Blizene Funjeb.
53. Zinc Phosphide	.. Ratox, Rod.
54. Ziram	.. Zirade, Cuman, Hexazir, Zerlate.

## PARTICIPANTS

<i>Sl. No.</i>	<i>Name</i>	<i>Designation</i>
<b>1. University of Agricultural Sciences, Bangalore.</b>		
1.	Dr. K. A. Jalihal ..	Director of Extension
2.	Prof. S. D. Kalolgi ..	Chief Scientific Officer (Horticulture) Regional Research Station, Mudigere.
3.	Dr. U. V. Sulladmath ..	Prof. of Horticulture, Gandhi Krishi Vijnana Kendra, Bangalore.
4.	Dr. P. B. Deshpande ..	Prof. of Chemistry and Soils, Hebbal.
5.	Mr. M. Jayaramaiah ..	Asst. Prof. of Entomology, Hebbal.
6.	Mr. M. Vishakantaiah ..	Entomologist (Pulses) Hebbal.
7.	Mr. Puttaswamy ..	Asst. Plant Protection Specialist, Hebbal.
8.	Mr. B.G. Muthappa Rai ..	Asst. Prof. of Horticulture, Gandhi Krishi Vijnana Kendra, Bangalore.
9.	Dr. P. Muddappa Gowda ..	Horticulturist (Olericulture), Gandhi Krishi Vijnana Kendra, Bangalore.
10.	Mr. P. Hanumappa ..	Extension Leader, E.E Unit Hebbal
11.	Dr. S. B. Puranik ..	Extension Leader, E.E Unit Regional Research Station, Raichur.
12.	Mr. N. R. Shanthamallaiiah ..	Agronomist, Regional Coconut Research Station, Arsikere.
13.	Dr. K.R. Thimmaraju ..	Assoc. Prof. of Horticulture, Gandhi Krishi Vijnana Kendra, Bangalore.
14.	Dr. M. M. Rao ..	Horticulturist (Pomology) Regional Research Station, Dharwad.
15.	Mr. V. M. Bankapur ..	Horticulturist (Olericulture), Regional Research Station, Dharwad
16.	Dr. N. Vijayakumar ..	Horticulturist, Gandhi Krishi Vijnana Kendra, Bangalore.
17.	Mr. P. B. Shanthappa ..	Farm Superintendent, Regional Coconut Research Station, Arsikere.
18.	Mr. K. Ramesha Melanta ..	Horticulturist (Pomology) Gandhi Krishi Vijnana Kendra, Bangalore.



19. Mr. J. V. Narayana  
Gowda .. Asst. Horticulturist, Gandhi Krishi  
Vijnana Kendra, Bangalore.
20. Mr. H. V. Pattanshetti Assoc. Prof. of Plantation Crops.  
Gandhi Krishi Vijnana Kendra,  
Bangalore.
21. Mr. H. A. Ramachandra Asst. Horticultural Specialist.
22. Mr. K. S. Krishnappa Junior Agronomist, AICPIR Sub-  
Centre, Gandhi Krishi Vijnana  
Kendra, Bangalore.
23. Dr. S. Srinivasan .. Extension Leader, E.E Unit, Regional  
Research Station, Mandya.
24. Dr. R. C. Yaraguntaiah Chief Scientific Officer (Plant Patho-  
logy, Regional Research Station,  
Mudigere.
25. Dr. C. V. Patil Asst. Prof. of Chemistry and soils  
Hebbal.
26. Mr. B. B. Madalageri Asst. Pomologist, Regional Research  
Station, Raichur.
27. Mr. P. Narayana Asst. Horticultural Specialist.  
Reddy .. Raichur.
28. Mr. G. S. Sulikeri Agronomist (Horticulture) Regional  
Research Station, Mudigere.
29. Dr. K. M. Bojappa Prof. of Horticulture, Agricultural  
College, Dharwad.
30. Mr. V. V. Sulladmath Asst. Pathologist, Regional Coconut  
Research Station, Arsikere.
31. Mr. M. M. Khan Asst. Horticultural Specialist, Hebbal
32. Mr. A. N. Sudarsan Asst. Plant Protection Specialist  
Rao (PP) Hebbal.
33. Mr. H. Krishnamurthy Technical Assistant to Director of  
Extension.
34. Mr. B. F. Hulagur Asst. Prof. of Chemistry and Soils,  
Hebbal.
35. Mr. A. Seshadri Iyer Information Specialist, Hebbal.

## II. Department of Horticulture, Bangalore

36. Mr. H. P. Ramakrishna Senior Asst. Director of Horticulture,  
Indo Bulgarian Project, Lalbagh,  
Bangalore.

- |     |                     |   |
|-----|---------------------|---|
| 37. | Dr. K. S. Chinnappa | Asst. Director of Horticulture,<br>(Trng.) Lalbagh, Bangalore.                            |
| 38. | Mr. Patalappa       | Asst. Horticultural Officer, Lalbagh<br>(Plant Protection), Bangalore.                    |
| 39. | Mr. Md. Habeeb Ulla | Asst. Director of Horticulture (Plant<br>Protection), Lalbagh, Bangalore.                 |
| 40. | Mr. H. Javaregowda  | Senior Asst. Director of Horti-<br>culture, Farm Information Unit,<br>Lalbagh, Bangalore. |

### III. Indian Institute of Horticultural Research (ICAR), Bangalore

- |     |                 |   |
|-----|-----------------|---|
| 41. | Mr. R. D. Rawal | Scientist (Plant Pathology) Indian<br>Institute of Horticultural Research<br>Bangalore. |
|-----|-----------------|---|
-

*Soma Mukherjee*  
Instructor in Entomology  
College of Agriculture  
Hebbal, Bangalore-560024.